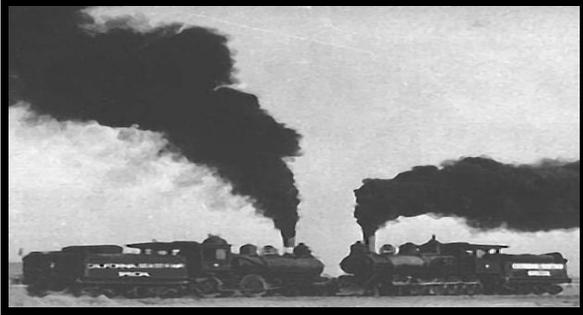


The Impulse-Momentum Theorem



Name: _____

Date: _____

Period: _____

Objective: Students will...

- ❖ Examine the relationship between impulse (as measured from the area under the curve of a Force v. Time graph) and the change in an object's momentum during a collision.

Safety:

- ❖ Be sure not to allow car plungers to strike the motion sensors or people.

Procedure:

1. Obtain a track, PASCO car, PASCO motion sensor with USB link, and a force sensor with USB link, and a force sensor mounting bracket. The force sensor should have a rubber nub rather than a hook on it.
2. Open file "11 Impulse CF" from the *Exp in Physics CF1.8* folder on the *student shared drive*.
3. Set up your track with the motion sensor at one end. Elevate the track *slightly* by placing a pen or pencil horizontally under the track 10cm from the motion sensor so that the track slants away from the motion sensor.
4. Mount the force sensor on its bracket at the lower end of the track with the rubber nub facing the track.
5. Be sure the plunger of the car is pushed all the way in and is facing toward the TOP of the track away from the force sensor.
6. Click "Start" on the computer. Quickly place the car above the pencil and let it roll naturally down the track. After it strikes the force sensor and bounces backward, click "Stop" on the computer.
7. On the Force v. Time graph, you should see a tall, thin spike. Highlight this spike and click the "Scale to Fit" button.

8. Adjust your scale so that your screen looks like the picture below. It is important that the bottom graph includes at least one point before and after the peak on the top graph. I've circled these points on the picture below



9. On the bottom graph, highlight the points just before and after the spike on the top graph.
- The first point is the velocity just before the collision, and the data box on the bottom graph calls this the "Max." velocity. Record this as v_{initial} .
 - The last point is the velocity just after the collision, and the data box on the bottom graph calls this the "Min." velocity. Record this as v_{final} .
 - Use these values to find the change in momentum of the car during its collision with the force sensor. Record these values.
10. On the top graph, highlight the graph for the exact same time period as you've highlighted on the bottom graph. The area under the curve of this spike is shown in gray. The data box on the top graph reports this area. Record this as Ft (Impulse.)
11. Clear your screen and repeat the procedure twice more.

Data Tables & Graphs: 12 points

	Mass of car (kg)	Initial Velocity of Car (m/s)	Final Velocity of Car (m/s)	Change in Momentum (kg·m/s)	Ft (Impulse) (N·s)	% Difference
Run 1	0.25					
Run 2	0.25					
Run 3	0.25					

Calculations: Show the following calculations. 2 points

- ❖ Calculation of change in momentum for run 1.
- ❖ Calculation of the percent difference between change in momentum and impulse for run 1.

Conclusion:

- ❖ Based on each of the three data runs, draw a conclusion about the relationship between impulse and the change in an object's momentum. Justify this conclusion by referring to your data trends.